



The Forty-Seventh Annual Report

OF THE

UNIVERSITY OF MARYLAND

Agricultural Experiment Station



College Park, Prince George County, Maryland

1933-1934

PUBLISHED BY THE STATION

The Forty-Seventh Annual Report

OF THE

UNIVERSITY OF MARYLAND

Agricultural Experiment Station



College Park, Prince George County, Maryland

1933-1934

PUBLISHED BY THE STATION

The University of Maryland Agricultural Experiment Station

The Board of Regents of the University of Maryland.

GEORGE M. SHRIVER, <i>Chairman</i>	Baltimore
JOHN M. DENNIS, <i>Treasurer</i>	Riderwood
W. W. SKINNER, <i>Secretary</i>	Kensington
WILLIAM COLE	Towson
HENRY HOLZAPFEL, JR.	Hagerstown
JOHN E. RAINES	Baltimore
CLINTON L. RIGGS	Baltimore
MRS. JOHN L. WHITEHURST	Baltimore

Executive Officer of the Board and President of the University,
RAYMOND A. PEARSON, College Park.

STATION STAFF

Harry J. Patterson, D.Sc., Director.

AGRICULTURAL ECONOMICS.

S. H. DeVault, Ph.D., Agr. Econ.
Ralph Russell, M.S., Assistant.
Paul Walker, M.S., Assistant.
Arthur B. Hamilton, M.S., Assistant.

AGRICULTURAL ENGINEERING.

R. W. Carpenter, A.B., LL.B., Engineering.
--

AGRONOMY (CROPS AND SOILS).

† J. E. Metzger, B.S., A.M., Agronomist.
W. B. Kemp, Ph.D., Agron. (Genetics).
G. Eppley, M.S., Asso. (Crops).
O. C. Bruce, M.S., Asso. Soil Technologist.
R. P. Thomas, Ph.D., Soil Technologist.
E. H. Schmidt, M.S., Assistant (Soils).
H. B. Winant, M.S., Assistant (Soils).
R. G. Rothgeb, Ph.D., Asst. Plt. Breeding.
R. L. Sellman, B.S., Assistant.

ANIMAL AND DAIRY HUSBANDRY.

DeVoe Meade, Ph.D., Dairy and Animal Husbandman.
B. E. Carmichael, M.S., Animal Husbandman.
W. E. Hunt, M.S., Associate, Animal Husbandry.
L. W. Ingham, M.S., Associate (Dairy Production).
M. H. Berry, M.S., Assistant Dairy Husbandry.
H. L. Ayres, Dairy Mfg.
W. C. England, Ph.D., Asst. (Dairy Mfg.).

ANIMAL PATHOLOGY AND BACTERIOLOGY.

R. C. Reed, Ph.B., D.V.M., Pathologist.
** A. L. Brueckner, B.S., D.V.M., Associate Pathologist.
L. J. Poelma, D.V.M., M.S., Assistant.
H. M. Devclt, D.V.M., Assistant (Poultry).
C. L. Everson, D.V.M., Assistant.
** Alex. Gow, D.V.M., Assistant.

* Agent U. S. Department of Agriculture.

† Assistant Director.

** Live Stock Sanitary Laboratory.

†† Dean of Graduate School.

** C. R. Davis, M.S., D.V.M., Assistant

** Irwin Moulthrop, D.V.M., Assistant

M. T. Bartram, M.S., Assistant (Meat Curing).

BOTANY, PATHOLOGY, PHYSIOLOGY.

† C. O. Appleman, Ph.D., Physiologist.
J. B. S. Norton, M.S., D.Sc., Pathologist.
C. E. Temple, M.S., Pathologist.
R. A. Jehle, Ph.D., Assoc. Pathologist.
Ronald Bamford, Ph.D., Assoc. Botanist.
Glenn A. Greathouse, Ph.D., Asst. Physiologist.
M. W. Parker, Ph.D., Assistant Physiologist.
J. W. Heuberger, Ph.D., Asst. Pathologist.
Neil W. Stuart, Ph.D., Asst. Physiologist.

ENTOMOLOGY.

E. N. Cory, Ph.D., Entomologist.
H. S. McConnell, M.S., Associate.
Geo. S. Langford, Ph.D., Associate.
L. P. Ditman, Ph.D., Assistant.
Geo. Abrams, M.S., Assistant (Bees).
C. Graham, M.S., Assistant.

HORTICULTURE.

J. H. Beaumont, Ph.D., Horticulturist.
T. H. White, M.S., Olericulturist and Floriculturist.
A. L. Schrader, Ph.D., Pomologist.
S. W. Wentworth, M.S., Associate Pomologist.
* F. E. Gardner, Ph.D., Pomologist (Plant Propagation).
F. B. Lincoln, Ph.D., Assoc. Plant Propagation.
H. B. Cordiner, Ph.D., Assistant Olericulturist.
W. A. Frazier, Ph.D., Assistant Canning Crops.
J. B. Blandford, Asst.-Farm Supt.

POULTRY HUSBANDRY.

R. H. Waite, B.S., Poultry Husbandman.
Geo. D. Quigley, B.S., Associate.

RIDGELEY SUB-STATION

Albert White, B.S., Superintendent.

SEED INSPECTION.

F. S. Holmes, M.S., Inspector.
Ellen Emack, Assistant Analyst.
Olive Kelk, Assistant Analyst.

Elizabeth Shank, Assistant.

The Station is located on the B. & O. R. R., City and Suburban Electric Car Line and the Baltimore-Washington Boulevard, eight miles north of Washington, D. C. Bell Telephone—Berwyn Exchange.

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge, to all residents of the State who request them.

ADDRESS:

AGRICULTURAL EXPERIMENT STATION,
COLLEGE PARK, MARYLAND.

CONTENTS

THE FORTY-SEVENTH ANNUAL REPORT EXPERIMENT STATION BULLETINS

	Page
Letter of Transmittal.....	v
Publications	vi
Contribution to the National Emergency Program.....	viii
Services Rendered Farmers.....	ix
Agricultural Economics	ix
Agricultural Engineering	x
Agronomy—(Crops and Soils).....	xii
Animal and Dairy Husbandry.....	xix
Animal Pathology and Bacteriology.....	xxi
Botany, Plant Physiology and Plant Pathology.....	xxiii
Entomology	xxvi
Home Economics	xxvi
Horticulture	xxvi
Poultry	xxvii
Tobacco	xxvii
List of Active Projects.....	xxvii
Financial Resources and Expenditures.....	xxxi
 Bulletin No. 351—July, 1933—The Soils of Maryland. By O. C. Bruce and J. E. Metzger.....	1
Bulletin No. 352—July, 1933—Farm Tenancy and Leasing Systems in Maryland. By W. P. Walker and S. H. DeVault.....	29
Bulletin No. 353—July, 1933—A Study of the Factors Influencing Red Color On Apples. By L. A. Fletcher.....	79
Bulletin No. 354—July, 1933—Use of Skimmilk Powder, Blood Flour, and Fish Meal in Grain Rations for Calves. By M. H. Berry.....	121
Bulletin No. 355—August, 1933—An Economic Study of 147 Turkey Flocks in Maryland. By S. H. DeVault and Mary Ingersoll.....	145
Bulletin No. 356—September, 1933—A Farm Management Study of 70 Dairy Farms in Montgomery County, Maryland. By Donald E. Watkins	177
Bulletin No. 357—October, 1933—Part-Time and Small-Scale Farming in Maryland. By W. P. Walker and S. H. DeVault.....	223
Bulletin No. 358—January, 1934—Fertilizer Tests With Tobacco. By J. E. McMurtrey, Jr., W. M. Lunn, and D. E. Brown.....	255
Bulletin No. 359—February, 1934—Feed Consumption Studies Based on the Six Maryland Egg Laying Contests. By Roy H. Waite.....	291
Bulletin No. 360—March, 1934—Cake and Biscuit-Making Qualities of Flours From Maryland Wheats. By W. B. Kemp, G. E. Eppley and Claribel Welsh	331
Bulletin No. 361—March, 1934—Potato Seed Maintenance. By R. A. Jehle and J. W. Heuberger. Spraying Early and Late Potatoes. By R. A. Jehle, E. N. Cory and R. T. Grant.....	345
Bulletin No. 362—April, 1934—Crop and Soil Management Practices. By Soils Department	365
Bulletin No. 363—May, 1934—Value of Natural Weed Fallow in the Cropping System for Tobacco. By D. E. Brown, and J. E. McMurtrey, Jr.	401
Bulletin No. 364—June, 1934—The Oriental Fruit Moth in Maryland. By H. S. McConnell.....	411

UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION

Volume 47

1933-34

THE FORTY-SEVENTH ANNUAL REPORT OF THE MARYLAND AGRICULTURAL EXPERIMENT STATION

For The Fiscal Year Ending June 30, 1934

BY H. J. PATTERSON, Director

To the Governor of Maryland, the Board of Regents, and the President of the University of Maryland:

Gentlemen: In compliance with the Federal and State laws providing for the Agricultural Experiment Station, there is presented herewith a list of research projects in progress and brief accounts of the results obtained together with a financial statement showing the receipts and expenditures for the fiscal year ending June 30, 1934. There is also appended copies of the bulletins issued during the year.

Economic conditions have caused the major interest of farmers to change from quantity to quality and efficiency in production. The agricultural depression has impressed farmers with the need for considering every factor which might lower the per unit cost of production and thus help increase net return for their labor. This condition has brought to the Station an increased number of problems in diseases, insect pests, soils, fertilizers, feeding stuff, crops, engineering, marketing, and other economic questions. Many of the leading problems today were unknown a few years ago—such as, vitamin carriers, virus diseases, spray residues, disease resistance, immunity, land classification and uses, plant propagation, new insects, and the transportation and distribution of products. These increased demands have been met in so far as possible, with the lessened State appropriations, by economy and many workers giving more hours of labor.

Though there is much said about apparent surplus production and quantity at present is no longer a problem, nevertheless the need for research is growing greater rather than less. Research has made possible the great agricultural advances during the last fifty years. Now conditions are changing rapidly and creating a demand for economic, social, industrial and agricultural information which was not contemplated a few years ago. It is quite important that new planning to meet the changed social and economic philosophy must be founded on the results of research.

PUBLICATIONS

The bulletins and papers published give a fair index to the results attained during the year. A study of the list below will show that many of the subjects relate directly or closely to some of the special emergency problems now confronting the people of this State.

Bulletin Number	Subject	BULLETINS	Author	Pages	Copies Issued
351	The Soils of Maryland	O. C. Bruce and J. E. Metzger		1-28	3,000
352	Farm Tenancy and Leasing Systems in Maryland	W. P. Walker and S. H. DeVault		29-78	2,500
353	A Study of the Factors Influencing Red Color on Apples	L. A. Fletcher		79-120	2,500
354	Use of Skimmilk Powder, Blood Flour, and Fish Meal in Grain Rations for Calves	M. H. Berry		121-144	3,000
355	An Economic Study of 147 Turkey Flocks in Maryland	S. H. DeVault and Mary Ingersoll		145-176	3,000
356	A Farm Management Study of 70 Dairy Farms in Montgomery County, Maryland	Donald E. Watkins		177-222	2,500
357	Part-Time and Small-Scale Farming in Maryland	W. P. Walker and S. H. DeVault		223-254	3,000
358	Fertilizer Tests With Tobacco	J. E. McMurtrey, Jr., W. M. Lunn and D. E. Brown		255-290	3,000
359	Feed Consumption Studies Based on the Six Maryland Egg Laying Contests	Roy H. Waite		291-330	3,500
360	Cake and Biscuit-Making Qualities of Flours From Maryland Wheats	W. B. Kemp, G. E. Eppley and Claribel Welsh		331-344	3,000
361	Potato Seed Maintenance Spraying Early and Late Potatoes	R. A. Jehle and J. W. Heuberger		345-356	
		R. A. Jehle, E. N. Cory and R. T. Grant		357-364	3,000
362	Crop and Soil Management Practices	By Soils Department		365-400	3,000
363	Value of Natural Weed Fallow in Cropping System for Tobacco	D. E. Brown and J. E. McMurtrey, Jr.		401-410	3,000
364	The Oriental Fruit Moth in Maryland	H. S. McConnell		411-456	2,500

TECHNICAL PAPERS

- Appleman, C. O.—The Relation of Anaerobic to Aerobic Respiration. American Society of Plant Physiologists, Boston, December, 1933.
- Appleman, C. O.—Philosophic Attitudes in Biological Research. American Society of Plant Phys., Boston, December, 1933.
- Bamford, Ronald—How the plant grows. Home Gardeners' School, College Park, April, 1934.
- Bamford, Ronald—Influence of the Land Grant College Movement on the Teaching of Botany. Agricultural Faculty, March, 1934.

- Beaumont, J. H. and R. F. Chandler—A Statistical Study of the Effect of Potassium Fertilizers Upon the Firmness and Keeping Quality of Fruits. Procedure American Society Horticultural Science, Vol. 30, 1933.
- Bishopp, F. C. and E. N. Cory, and Alan Stone—Preliminary Results of a Mosquito Survey in the Chesapeake Bay Section. Proceedings Washington Entomological Society, Vol. 35, No. 1, January, 1933.
- Brueckner, A. L.—Equine Encephalomyelitis. Agricultural Experiment Station and College of Agriculture Staff Faculty Meeting.
- Brueckner, A. L.—Equine Encephalomyelitis. Maryland State Veterinary Medical Association.
- Chandler, R. F.—The Replaceable Potassium Content of Orchard Soils in Maryland as Affected by Potassium-Carrying Fertilizers. Procedure American Society Horticultural Science, Vol. 30, 1933.
- Chandler, R. F.—A Study of the Effect of Various Potassium Carrying Fertilizers Upon the Growth and Yield of Apples and Peaches. Procedure American Society Horticultural Science, Vol. 30, 1933.
- Cordner, H. B.—External and Internal Factors Associated with Set of Fruit and Dropping of Blossoms in Lima Beans. Procedure American Society Horticultural Science, Vol. 30, 1933.
- Cory, E. N.—The Codling Moth Situation on the Eastern Shore of Maryland. Transactions of Peninsula Horticultural Society, Vol. 23, No. 5, 1933.
- Cory, E. N.—Notes on Codling Moth Control in 1933. Journal of Economic Entomology, Vol. 27, No. 2, April, 1934.
- Cory, E. N.—Some New Vegetable Insects. Report of the Vegetable Growers Association, 1934.
- DeVault, S. H.—Marketing of Maryland Farm Products. The Agricultural Industry of Maryland, Chapter XXI, Baltimore Association of Commerce, 1934.
- DeVault, S. H. and W. J. Hart—Set-Up of Project for Marketing of Tomatoes. In Volume of Social Science Research Council on Marketing of Farm Products.
- DeVolt, H. M.—Recent Developments in Poultry Practice. Summer Meeting of the Maryland State Veterinary Medical Association at College Park, Md., June 28-29, 1934.
- Ditman, L. P. and E. N. Cory—Corn Earworm Studies. Experiment Station Bulletin No. 348.
- Ditman, L. P. and E. N. Cory—The Response of Corn Earworm Moths to Various Sugar Solutions. Journal of Economic Entomology, Vol. 26, No. 1, February, 1933.
- Eppley, Geary—The Improvement of Hay in Maryland. Maryland Crop Improvement Association, 27th Report.
- Greathouse, Glenn A. and M. W. Parker—An Improvised Dilatometer for Plant Materials. American Society Plant Physiologists, Boston, December, 1933.
- Harry, D. G., S. H. DeVault, and W. P. Walker—Report of Committee on Taxation. Annual Report of Maryland State Grange, 1933.
- Kemp, W. B. and P. R. Henson—The Effect of Type of Endosperm upon Carbohydrate Distribution in the Mature Corn Plant. Journal American Society Agronomy, Vol. 26, No. 6.
- Kemp, W. B.—Some Methods for Statistical Analysis. Journal American Statistical Association, June, 1934.
- Langford, George S.—Winter Survival of the Potato Tuber Moth, *Phthorimaea operculella* Zell. Journal Economic Entomology, Vol. 27, No. 1, February, 1933.
- Marquis, Clyde and Ralph Russell—Progress of Cooperative Marketing in 1933. National Association Marketing Officials Annual Report, 1933.
- Matthews, W. A.—Influence of Distance of Planting on Yield of Snap Beans. Procedure American Society Horticultural Science, Vol. 30, 1933.
- Metzger, J. E.—The Alfalfa Soils of Maryland. Maryland Crop Improvement Association, 27th Report.
- Metzger, J. E.—Fertilizers under the Agricultural Adjustment Act. Vegetable Growers' Association, 1933 Report.
- Norton, J. B. S. and J. W. Heuberger—The structure of the Microconidia of *Sclerotinia fructicola*. American Phytopath Society and Mycological Society of America, Boston, December, 1933.
- Poelma, L. J.—Brucella Abortus Infection of Horses. Summer Meeting of Maryland State Veterinary Medical Association, College Park, Md., June 28-29, 1934.
- Poelma, L. J.—Serums, Vaccines and Immunity. Maryland State Veterinary Medical Association Winter Meeting.
- Rothgeb, R. G.—Field Trials with Sweet Corn Hybrids and Varieties in Maryland. The Canner, Vol. 78, No. 19.
- Schoening, H. W. and A. L. Brueckner—Equine Encephalomyelitis (Round-Table Discussion of).
- Schrader, A. Lee—The Biennial Bearing Problem of Apples. Transactions Peninsula Horticultural Society, 1933.
- Wentworth, S. W.—Pollination of Apples. The Maryland Fruit Grower, March and April, 1934.
- Wentworth, S. W.—Apple Pollination Studies in Maryland. Procedure American Society Horticultural Science, Vol. 30, 1933.
- Woods, Mark W.—Intracellular Bodies Associated with Ring-spot. Contributions from Boyce Thompson Institute, 5: 3, July-September, 1933.

THE EXPERIMENT STATION HAS CONTRIBUTED TO
THE NATIONAL EMERGENCY PROGRAM ON
THE FOLLOWING PROJECTS:

1. The adjustment of production of wheat, corn and hogs, and tobacco under the A. A. A. has been carried out by the University Extension Service. Members of the Experiment Station Staff have given assistance in making the detailed plans.
2. The Department of Agricultural Economics organized and directed the following projects or surveys for the Farm Credit Administration.
 - (a) Cash Cost of Production of Farm Crops.
 - (b) Reaction of Maryland Farmers to Experience with Federal Credit.
 1. Regional Agricultural Credit Corporation.
 2. Crop and Seed Loans.
 3. Mortgage Loans through Federal Land Bank.
 4. All Other Federal Agencies Making Loans to Farmers.

This survey covered seven counties and necessitated personal interviews with ninety-five farmers. A summary of the findings was prepared for the Farm Credit Administration.

3. The Department of Agricultural Economics organized and directed the following projects and surveys for the C. W. A.
 - (a) A Study of the Reasons and Causes of Rural Families Needing Relief.
 - (b) The Causes of Farm Tax Delinquencies and Mortgage Foreclosures.
 - (c) This Department also gave some help on planning the survey on the need for modernizing of rural houses, conducted by the Extension Service.
4. The departments of Agricultural Economics and Agronomy cooperated in making surveys of tracts of land suitable for establishment of subsistence farms.

Some surveys were also made for the U. S. Department of Interior of the small and part-time farms in Maryland, to procure some data to supplement that covered in Maryland Station bulletin 357.

5. The Department of Entomology cooperated with the U. S. Department of Agriculture, Bureau of Entomology, in conducting their program for Mosquito Control.
6. The Departments of Agricultural Economics and Dairy Husbandry have cooperated in some emergency studies of the Milk Control problem.
7. Many members of the Experiment Station Staff have given much time to conferences and preparing tentative plans for land use programs and crop adjustments. Most members of the Station Staff have contacted one or more of the emergency projects.

SERVICES RENDERED FARMERS

The Experiment Station Staff renders farmers much help in addition to the bulletins published by giving advice and answering inquiries through correspondence, personal interviews, special visitations, conferences; addressing meetings of clubs, associations and societies; radio talks; and preparing articles for the press. Much time is also given to the diagnosis of animal and plant diseases; identification of insects, plants, and seeds; testing the purity and vitality of seeds; determining the lime requirement of soils; preparing and distributing legume inoculums, and animal serums.

Attention is called to the following matters which have been compiled from the many which are covered in the annual reports of the different subject matter departments.

AGRICULTURAL ECONOMICS

It will be noted that four of this year's bulletins were issued from this department. Several more bulletins are in preparation and will soon be ready for distribution. This department, in addition to the regular program, gave much time to assisting and directing the Federal Emergency programs and projects.

The Farm Tax problem has received much study in an effort to determine an equitable readjustment of the tax load and also to find the factors involved in the causes of tax delinquency. The information was obtained from the County Treasurers' records, the County Commissioners' records and the Court records.

A total of 26,453 farm real estate tax delinquent records, 1,371 farm tax sales and 7,376 land transfers were obtained for the years 1928 to 1932 inclusive. Preliminary tabulation of the data for the tax delinquent records shows that 17,058 tracts of land of three acres or more, involving 1,468,737 acres were tax delinquent to the extent of \$947,762 in the fiscal year 1932-33 (the latest fiscal year in which data for all counties were available).

There are in Maryland approximately 75,000 tracts of land of three acres or more in size. Therefore, in 1932-33 about 23 per cent of the farm tracts were tax delinquent. Total farm real estate taxes outstanding, as of December 31, 1933 for all levies prior to 1933-34, amounted to \$836,638.

The facts collected will probably prove helpful in formulating tax legislation.

A Study of the Relief Needs of Rural Families:

This project was sponsored by the Division of Research and Statistics of the Federal Emergency Relief Administration.

The study is divided into two parts as follows: A Study of the Relief Needs of Rural Families as of October, 1933; and A Study of Non-Relief Families as of October, 1933. The first part of the survey is intended to amplify the information obtained by the Unemployment Relief Census conducted throughout the country. It is designed to show the composition of the household; the occupational history, farm tenure and mobility of the head of the household; the employment status of members of the household other than the head; the economic status of the household; and the types and sources of public and private relief and other extraordinary forms of aid for rural relief households.

The information obtained in this survey will furnish bases for determining the types of rural households receiving relief from public funds and for appraising the occupational and economic resources of these households. This information will show also the extent to which rural relief households have been affected by various Federal, State, and local forms of assistance. The cases included in the survey are from farm and village households which received relief in October, 1933. This study is being conducted in the same counties as were selected in the farm relief study.

The information was obtained by means of a questionnaire by personal visitation to the rural households in three counties in Maryland. About 300 relief families and 600 non-relief families were studied.

This project will be continued into the fiscal year 1934-35. At the present time a third phase of the project, dealing with the rehabilitation of rural relief families, has been inaugurated.

AGRICULTURAL ENGINEERING

State Projects in Rural Electrification

Development of Small Electric Milk Pasteurizer:

This project has for its purpose the development of a 10 to 20 gallon batch pasteurizer using the milk conductor method of electric heating. Tests were made with a 10 gallon nickel lined

cylindrical tank with a center carbon electrode, and with a rectangular glass tank with two rectangular carbon plate electrodes. Electricity was passed through the milk between electrodes to produce heat. The glass tank and carbon electrodes were found most satisfactory. Metal electrodes and metal containers corroded very noticeably with high current densities. A progress report is to be issued. Some additional work is necessary for making and testing a commercial model. The project was continued from 1932.

Electric Soil Sterilization:

Work was continued in the development of a process of soil sterilization by passing a current of electricity through the soil of a greenhouse bench. It was found that the soil could be heated to sterilizing temperatures by passing current between a galvanized iron plate placed in the bottom of the bench and a heavy iron plate placed on the surface of the soil. With a voltage of 220 and current of 25 to 60 amperes, blocks of soil could be heated to the steaming point in 30 minutes. The sterilizing temperature carries an inch or more beyond the edge of the top plate. It was necessary to sprinkle the soil surface before placing the top plate in position and to use care in getting good contact between the plate and soil. Iron plates of $\frac{1}{4}$ inch thickness were found to be most satisfactory. Further work is necessary with lower voltages and for developing an economical technique and safety precautions.

Mushroom Culture in Electric Hotbeds:

Studies were made of the possibility of growing mushrooms (*Agaricus campestris*) in electrically heated hotbeds during the winter season. The project had three objects:

1. To learn the temperature, moisture, compost, and other conditions necessary to grow mushrooms in electric hotbeds.
2. The utilization of equipment which would otherwise be idle.
3. The use of mushroom compost as a fertilizer for garden beds.

It was found that mushrooms could be grown satisfactorily during the winter months with temperatures ranging down to -10° F. in the electrically heated beds, whereas mushrooms spawned in identical beds without electric heat did not grow. Temperatures of 65° and higher produced quick growing mushrooms with long stems. Temperatures of 55° to 60° produced a good quality of mushrooms with medium stems. Temperatures of 45° to 50° produced slow growing, firm mushrooms with short

stems. Below 45° there was very little production and the mushrooms which did grow had practically no stems. Heat applied above the soil tended to dry and crack the mushroom caps. Heat applied beneath the compost dried the compost and used a maximum of electricity. The best location for the heating elements was found to be on the surface of the compost and beneath the casing soil.

Temperature Control in Electric Hotbeds:

Studies of temperature control were continued from past years. The studies this year included an attempt to hold constant temperatures by using opaque insulated covers over the glass sash of the beds. With such an arrangement it was found possible to hold bed temperatures quite uniform during the winter months by placing the heating cables on the surface of the soil or in the air above the soil, with a thermostatic switch control in the same position.

Progress was made in the development of a low-cost temperature control for electric hotbeds, in cooperation with commercial companies. The project aims at the development of a thermostat which can be sold for \$3.00. Present prices are \$6.00 and upwards.

Electric Fruit and Vegetable Drier:

Research on a small electrically heated home drier for fruits and vegetables was continued. A low-cost portable fan type heater such as is sold for room heating was substituted for space heating elements used in a small drier in previous tests. The fan type unit speeded the drying time about 20% and reduced the power consumption. The heater could be easily removed from the drier for use elsewhere. A supplementary report was issued giving results of the test.

Extending the Farm Use of Fractional Horsepower Electric Motors:

A very simple base and handle was devised for changing the ordinary fractional horsepower motor into a portable unit. The change can be made with materials available on the farm and at practically no cost. The motor can then be used for numerous small power jobs on the farm. (Extension Circular 105.)

AGRONOMY—(Crops and Soils)

The crop year of 1933-34 was favorable for some crops but unfavorable for others. The excessive rain and cloudy, humid weather caused a heavy loss on the wheat crop due to scab infection. The hay crop on the other hand was unusually good, some of the fields averaging approximately 2 tons per acre in the first

cutting. The corn crop was exceedingly promising and would have been better than average had there not been a severe rain and wind storm during the month of August. The soybeans for both hay and seed yielded unusually well. They were not materially injured by the storm. Growth conditions during the autumn were unusually favorable, with the result that fall planted cereal grains attained rather too much vegetative growth. Although the winter was unusually severe the spring growth conditions were very favorable.

The classification and information regarding Maryland soils, given in bulletin 351, has proven very helpful to farmers, but it has been particularly useful to land appraisers in estimating the producing capacity of different soils and its probable ability to ultimately pay off a loan.

The results of a number of experiments given in bulletin 362 are very practical and should answer questions frequently asked.

Smooth Awned Winter Barley for Maryland:

Strains of winter barley with smooth awns (beards) have been developed and are now undergoing critical comparison in the field with established sorts.

These new strains all have awns, but unlike the awns on the barley now being grown in the state, they are practically free of barbs or the sharp, slanting projections with cause so much discomfiture to man and animals. Because of its softness, smooth awned barley is more agreeable to handle than awned wheat.

The barley strains being tested with much promise were isolated from a cross made in 1926 between Tennessee Winter and Velvet. The former is a rough awned winter variety extensively grown in Maryland, while Velvet is a spring barley with smooth awns but not at all adapted to local conditions.

From the cross many distinct types were isolated, but only those with relatively smooth awns and good field performance have been retained. Five selections are now being increased. It is hoped that seed of one or two of the better ones can be placed in the hands of the growers in the fall of 1935. There is every reason to believe that one or more of these selections will find ready acceptance by the farmers of Maryland just as soon as the seed can be multiplied for distribution.

New Wheat Selections:

Leapland for High Lands: It is a selection of the Leap variety. The Leapland has given for six years an average yield of 3.6 bushels more than Leap and 4.5 bushels more than Mammoth Red. Past performances indicate that Leapland can be profitably used on much of the wheat acreage of Maryland.

Mammoth Red for Low Lands: This variety is disease resistant and suited to the low land. It now occupies the major part of the acreage on the Eastern Shore and the lower limestone valleys of Washington and Frederick Counties.

Sweet Corn. Seed Production and Breeding:

As in 1932 four lines of work were carried in 1933, namely (1) variety and hybrid testing, (2) production and crossing of inbred lines, (3) adaptation of Connecticut strains to Maryland conditions, (4) improvement of a local variety, Hopeland.

In 1933 a total of 37 varieties and hybrids were grown in field trials at College Park.

Golden Cross Bantam, a yellow hybrid produced at the Indiana Station, continued to perform well in these annual trials. In 1933 it tied with Evergreen for yield of canning ears per plant. Compared with a good commercial strain of Evergreen it has averaged about one-quarter ton more per acre of husked ears suitable for canning for the years 1932 and 1933.

Hopeland, a high-producing sugar corn, was developed at the Maryland Station in 1920 from a cross between Stowell's Evergreen Sweet Corn and Johnson County White Field Corn. It has been selected yearly for uniformity, type and desirable qualities. It has always given high yields but lacks in sweetness and tenderness. It is a tall late corn relatively resistant to corn earworm injury. Effort to improve the quality of this sweet x dent cross continued in 1933. Crosses were made with other sweet corn and the resulting progenies are being observed in 1934. More than 100 inbred Hopeland lines have gone through the second generation of inbreeding. The aim is to unite Hopeland vigor with tenderness and flavor of kernel. Last year open pollinated Hopeland ranked third in the variety test for tonnage of husked ears suitable for canning, being surpassed only by first generation hybrids. Also it showed a minimum of damage by the corn earworm.

Hay, Forage and Pasture Crops:

Alfalfa—The project of testing various strains of alfalfa started in 1928, was continued through the 1933 crop season, giving five years results. The recommendation for Maryland based upon this test is to use seed from Kansas or from states further north, and avoid Turkestan and Arizona seed which is the Hairy Peruvian type. One of the most interesting results secured was the comparison between Grimm and Kansas Common alfalfa seed over which there has been considerable controversy. In the test there were two different strains of Kansas seed, and a Montana Grimm and a Utah Grimm. Taking the

yields of both Kansas seed grown on duplicate plots for the five year period and comparing them with the two Grimm strains under the same condition the results were:

Average of 2 Kansas strains for 5 years.....3.15 T. per Acre.
 Average of 2 Grimm strains for 5 years.....3.16 T. per Acre.

Kentucky Bluegrass—In cooperation with the Scarlett Seed Company a test was started to determine the quality of Kentucky Bluegrass as indicated by the weight per bushel. Scarlett furnished three lots of Kentucky Bluegrass seed weighing respectively 17 lbs., 19 lbs., and 21 lbs. per bushel. This was seeded at the rate of 100 lbs. per acre and 50 lbs. per acre and at each rate the plots were duplicated. On each of the four series the seed weighing 19 lbs. per bushel gave the best stand in the fall and showed a thicker sod in the spring, the 21-lb. rate next, and the 17-lb. rate poorest.

Effect of Salt Water on Soils:

Some work was done upon the effect of overflow salt water on Maryland soils. This was the outgrowth of the heavy storm of August, 1933, which drove the salt water over considerable acreage of land on the eastern shore and the western side of the Bay. Large numbers of samples were taken at random over these areas. On these samples the following determinations were made: Soluble salts, pH value, available plant food, chlorine content, exchangeable calcium, magnesium, sodium and potassium. The results of these determinations indicate that although there was considerable salt left in the soil immediately following the flooding it did not continue in the soil very long, or cause any noticeably injurious effects. The samples were taken from one to two months after the undulation and many of the soils contained no more soluble salt than the unflooded section at that time. No physical injury was noticed in any of the soils. This is another indication that the soils were not affected markedly by the salt. There was a tendency for an increase in the amount of exchangeable magnesium and to some extent calcium. Some soils had an increase in the amount of exchangeable potassium, some did not. The sodium apparently did not enter in the exchange compound. All of the soils were low in their available phosphorus so the recommendations for heavy applications of superphosphate should have been very timely.

Tests for Available Potash:

Another investigation which has been in progress some time is the use of the so-called available potash tests upon some Maryland soils. Briefly it may be said that no single test was wholly satisfactory on all of the soils tested.

Effect of Organic Matter on the Fertility of Leonardtown Loam:

The plots on which this study is being made were changed in the spring of 1933 to their present location, which is slightly east and south of the new Horticultural Building. The rotation is a two year one of barley and tomatoes, with different cover crops in between these two crops in order to incorporate organic matter in the soil. The first crop grown was tomatoes in 1933. The cover crops of grass and legumes were seeded in the spring of 1933 to be turned under in the spring of 1934, but unfortunately very little growth was made on any of these plots. As a result the organic matter has had no effect. The green manuring or organic matter crops seeded last fall and this spring in the barley have started off well and there should be excellent growth to turn under next spring. The laboratory work, both chemical and biological in nature, has shown very little difference so far. The organic matter content of the individual plots is about the same. As the fertility of the plots is rather high, there has been obtained a high total in the number of organisms. The hydrogen-ion concentration of these plots has been seven or above. This is because of the lime applications in the past. There has not been a large accumulation of nitrate nitrogen. This is probably because it was used by the crops growing as rapidly as it was nitrified. Although manure is included as one of the sources of organic matter in the plan of study none has been applied. This is because of the unsatisfactory growth of the green manuring crops to turn under and it did not seem advisable to give the manure plots a year's start over the green manure plots.

Field Studies of the Fertility Requirements and Management of Important Soil Types:

La Plata: The change of rotation which was made two years ago seems to be very profitable. Excellent stands of sweet clover were obtained. This would have supplied the much needed organic matter to the soil if the sweet clover had not been removed for hay the first year. In doing this it was cut too close and all the sweet clover killed. Practically all fertilizer treatments as tried on this field have given increases, although manure and phosphorus have been the most outstanding. This field is to be discontinued with this year's wheat crop.

Princess Anne: The 1933 crops would have been very satisfactory if it had not been for a severe storm in August. This practically destroyed the corn and soybean crops. Good wheat and timothy hay mixture yields were obtained. The outstanding fertilizer treatment has been the 3-12-12. Manure is still giving the highest yields. In testing these plots for their lime require-

ment it was found that all were very badly in need of lime. Range 2 was limed last fall and Range 4 this spring. Ranges 1 and 3 are still in the need of lime.

Ridgely: The corn, wheat and barley yields on this field were very good. The manure when supplemented with superphosphate or rock phosphate has given consistently the highest yields. On B section, where the fertilizer is different from that outlined originally, a complete fertilizer high in phosphorus has been next to the manure and phosphorus plots in yield. On Section A of the individual fertilizer ingredients, phosphorus is still giving the best returns. The plot receiving nitrate of soda, superphosphate and muriate of potash has given consistently better yields than any of the incomplete fertilizer mixtures.

Station Farm Crops:

Summary tables such as the one which follows have been included in the annual report for a number of years. Values such as these may not be used as representing farm costs in general. They are valuable, however, for comparative purposes and they are representative of farming costs and incomes for this particular farm. It is unfortunate, of course, that some of the land involved is of such low quality as to materially reduce the net returns.

NET VALUE OF THE CROPS AND A SUMMARY OF THEIR PRODUCTION COSTS—1933

* The cost of baling wheat straw was \$1.61 per ton, and of barley straw \$2.10 per ton. This difference in cost was due mainly to the fact that wheat threshing and baling was done in one operation, while the barley was threshed and the straw blown in a pile and then baled.

The costs are included in the above table. Also, approximately 12 tons of straw from the wheat and barley variety plots were baled and stored.

ANIMAL AND DAIRY HUSBANDRY

A Test of Fish and Linseed Meal for Fattening Steers:

This test was conducted in cooperation with Major H. C. Davidson on his farm at Oraville, St. Mary's County. The test was started with 50 steers. They were fed for 252 days. All the feeds were farm grown except the fish and linseed meals. Detailed results are given in the following table:

	Lot 1 Linseed Oil Meal Lbs.	Lot 2 Fishmeal Lbs.
Initial weight 1/12/33	11535	11570
Final weight 9/21/33	21190	21240
Steer Days *	5807	5880
Gain in weight	11926	11945
Average daily gain per steer	2.05+	2.03+

Feeds Consumed:

Ground Corn and Cob	32969	35909
Ground Corn	27450	29543
Ground Barley	9962	11079
Linseed Oil Meal	15860	—
Fishmeal	—	8614
Roughage Weighed and Estimated	22320	22445
(Alfalfa and Soybean Hay)		
Corn Stover, not charged	—	—

Feeds (not including all roughage) consumed per 100 lbs. gain in weight:

Ground Corn and Cob Meal	276.45	300.62
Ground Corn	230.17	247.33
Ground Barley	83.53	92.75
Linseed Oil Meal	132.99	—
Fishmeal	—	72.11
Roughage (Alfalfa and Soybean Hay)	187.15	187.90
Corn Stover undetermined	—	—
 Total	 910.29	 900.71

* Lot 1—One steer out March 20, estimated weight 611 pounds. Three steers out May 4, 2415 pounds. One steer returned June 1, 755 pounds. Total steer days, 5807.
 Lot 2—Three steers out May 4, 2275 pounds. Total steer days, 5880.

Raising Calves on Remade Skim Milk with Fishmeal:

The method described in Bulletin 354 for feeding calves has been continued with more calves. Three of them have reached the age of six months with an average daily gain respectively of 1.32, 1.15, and 1.04 pounds.

Advanced Registry Tests:

During the past year Advanced Registry testing has been carried on in the Experiment Station dairy herd with a number of cows. Twenty-two cows have met the requirements of the sev-

eral breed associations in milk and butterfat production and have established records as indicated in the following tabulation:

ADVANCED REGISTRY RECORDS

Name of Cow	Reg. No.	Breed	Lbs. Milk	Lbs. Fat	Class or Age	Days in Milk
Governor's Rosette of Rossbourg	195967	Guernsey	9579.2	406.0	A	365
Warrior's Rose of Rossbourg.....	273295	Guernsey	9959.9	426.4	D	365
Warrior's Rossbourg Poinsettia..	335422	Guernsey	8524.7	391.1	G	365
Warrior's Rosette of Rossbourg..	335424	Guernsey	7099.7	350.0	G	328
		Total	35163.5	1573.5		
		Average	8790.9	393.4		
Jacoba's Tormega of W.....	708098	Jersey	9332.0	467.23	Mature	365
Xenia's Beauvoir Beauty.....	889786	Jersey	9671.0	561.6	Jr. 3	365
Diamondback Caroline.....	929698	Jersey	7487.0	352.7	Jr. 2	365
		Total	26490.0	1381.5		
		Average	8830.0	460.5		
Leto's Winsome Cherry.....	102604	Ayrshire	9542.0	335.0	Mature	305
Leto's Winsome Maes.....	103542	Ayrshire	10535.0	390.1	Mature	305
Leto's Lady Maes.....	111692	Ayrshire	8276.0	323.0	Mature	305
Salome Queen Douglas.....	88051	Ayrshire	8514.0	328.0	Mature	305
Leto's Miss Maes.....	112747	Ayrshire	7701.8	351.3	Jr. 4	305
Leto's Salome Macs.....	113533	Ayrshire	9006.0	350.5	Jr. 4	305
Leto's Bloomer Maes.....	122612	Ayrshire	10380.0	407.0	Jr. 2	365
Leto's Pretty Maes.....	130724	Ayrshire	7043.0	298.9	Jr. 2	305
Leto's Snowdrop Maes.....	130725	Ayrshire	7242.0	330.3	Jr. 2	305
		Total	78239.8	3114.1		
		Average	8693.3	346.0		
Rolo Fairview Pet 2nd.....	1387120	Holstein	10743.9	369.4	Jr. 3	291
Brooklandwood Frances.....	1446378	Holstein	10939.1	340.7	Jr. 2	305
Konigen Barbara Jane.....	1450687	Holstein	9954.6	302.8	Jr. 2	305
Brooklandwood Mary.....	1446379	Holstein	11283.4	367.6	Jr. 2	365
Johanna Queen Belle.....	1446380	Holstein	12946.2	457.7	Jr. 2	365
Glenham Inka May Ann.....	1559136	Holstein	10523.6	339.0	Jr. 3	305
		Total	66390.8	2177.2		
		Average	11065.1	362.9		
		Gr. Total	206284.1	8246.3		
		Av. 22 Hd	9376.6	374.8		

SUMMARY OF PRODUCTION BY BREEDS

Breed	No. of Cows On Test	Average Milk Pounds	Average Fat Pounds
Guernsey	4	8790.9	393.4
Jersey	3	8830.0	460.5
Ayrshire	9	8693.3	346.0
Holstein	6	11065.1	362.9
All Breeds	22	9376.6	374.8

Leaving out of consideration the factor of age, the Jerseys produced the most butterfat and the Ayrshires the least. The average production of all twenty-two individuals of the four breeds was 9376.6 pounds of milk and 374.8 pounds of fat.

Several bulletins are ready for publication giving the results of experiments with sheep and quality of hams. These will soon be available and abstracts of the results will not be given here.

ANIMAL PATHOLOGY AND BACTERIOLOGY

Most of the research projects in this department on animal diseases are conducted in cooperation with the Maryland Live Stock Sanitary Laboratory and they are closely correlated with the major disease problems prevalent in this State.

Economic Loss from Abortion in Dairy Herds in Maryland:

A Study of the Economics of Clean and Infected Dairy Herds (Contagious Abortion) (Bang's Disease): This study has been conducted jointly by the Live Stock Sanitary and Biological Laboratory Staff and the Department of Agricultural Economics. During this third year of the study, records have been kept on seven herds consisting of 289 cows. Eighty-one of these cows were positive reactors to the agglutination test for Bang's disease. A comparison of the records of the positive cows with the negative cows, compiled by the Department of Agricultural Economics, is shown in the following table:

Item	Reaction		Gain of Negative Over Positive
	Positive	Negative	
Number of cows in herds.....	81	203	
Number of producing cows in herds.....	75	171	
Average number of months in milk per cow.....	8.1	8.5	.4
Number of services per conception.....	1.6	1.4	.2
Number of calves per cow year.....	.84	1.12	.28
Per cent. normal calvings.....	78.1	89.5	11.4
Milk produced per cow (pounds).....	5,628.8	6,041.5	412.7
Milk production per cow (adjusted for age) (Lbs.).....	6,664.8	6,918.4	253.6
Fat produced per cow (pounds).....	232.8	255.9	23.1
Value of product per cow year above cost of feed	\$71.92	\$89.13	\$17.21
Average value of healthy calves per cow year	\$2.18	\$3.03	\$.85
Net return per cow.....	\$74.10	\$92.16	\$18.06

The above data show that it is economically worth while to eradicate the disease from our herds. The difference between the returns from the positive and negative cows for 1933 is not so great as it was in the two previous years. This may be accounted for by the fact that the owners have followed the plan of culling out the low producers from the reactors, leaving only the better animals of this group in the herd. The negative cows still show a marked advantage over the positive ones from an economic standpoint.

Poultry Disease Research:

In poultry diseases the major project is a study of Blackhead of Turkeys. The following is a brief summary of the progress of this project from 1927 through 1933:

Control of the Disease: Turkey poult's have been reared free from the disease by incubator hatching and rearing them either in experimental cages or on fresh soil not frequented by adult turkeys or chickens.

Transmission: This work was undertaken to demonstrate the prevalence of the Blackhead parasite, and also as a preliminary step toward the isolation and identification of the causative agent. It has been possible to transmit the disease in the following ways:

- a. Rearing poult's with the turkey-hen.
- b. Permitting turkey poult's to range with chickens.
- c. Rearing poult's in experimental cages containing top soil from the turkey breeder or chicken yard.
- d. Inoculating poult's orally and per vent with suspensions of lesion tissue.
- e. Inoculating poult's with modified Lock's media cultures of Histomonads.

Flies: Evidence has been obtained which indicates that flies may carry the causative parasites into the pen.

Cecal Protozoan Fauna of Turkeys: The microscopic examination of cecal evacuations has led to the identification of five protozoan genera, all of which have been propagated in the laboratory on artificial media. In addition to the highly pathogenic *Histomonas meleagridis*, *Trichomonas gallinarium* has appeared to be pathogenic on some occasions. *Chilomastix gallinarium*, *Entamoeba gallinarium*, and *Pygolimax gregariniformis* have not been found to be pathogenic.

Subcutaneous Blackhead: It has been possible to reproduce Tyzzer's "Subcutaneous or Inoculated Blackhead."

New Form of Blackhead: It has been possible to produce an apparently new form of the disease by making sinus inoculations with lesion tissue.

*Artificial Cultivation of Intestinal Protozoa—Cultures of *Histomonas meleagridis** (causative agent of Blackhead) have been propagated on artificial media for about five months prior to this time during which the cultural methods have been improved and preliminary steps taken toward freeing the cultures from contaminating intestinal bacteria.

Using Trichomonads as an example, it has been possible to develop colonies from a single trophozoit and demonstrate the effect of a change in culture media in causing polymorphism.

BOTANY, PLANT PHYSIOLOGY AND PLANT PATHOLOGY

Progress reports on some projects have been published in scientific journals and society proceedings. Some are about ready for publication as bulletins. Abstracts of them will not be given here.

Plant Physiology:

Physiological and Biochemical Aspects of Vegetable Storage: Experimentation was continued along the same lines as last year but extended to a larger variety of vegetables. The results have suggested a modification of Kostychev's theory of the relation of anaerobic and aerobic respiration.

Symptoms of Mineral Nutrient Deficiencies in Plants, with Special Reference to the Tomato: Experiments were repeated to further confirm the symptoms of mineral nutrient deficiencies in the tomato plant previously reported. Tomato plants were also grown in solutions with excesses of the essential elements, but no distinctive responses or symptoms could be detected for excesses of the various elements. The concentration of calcium in the culture solution was increased by increments up to four hundred parts per million. The optimum heights and weights were obtained from tomato plants receiving one hundred and sixty parts per million of this element. On either side of this concentration a decrease in all growth measurements occurred.

A Physiological Study of the Resistance and Susceptibility of the Tomato Plant to Fusarium Wilt: During the past year special emphasis was placed upon the effect of varying the concentration of calcium on the susceptibility to wilt disease. The Marglobe variety, which possesses natural immunity to this disease, was found to be quite susceptible in nutrient solutions with concentrations of calcium below 160 p. p. m. Varying the concentrations of calcium through a wide range had no significant effect on the susceptibility of the Bonnie Best variety to the wilt disease. Some new lines of experimentation were undertaken during the past year. These experiments were concerned with the toxicity of extracts of the fungus mats, and also with the inhibitory action on the growth of the fungus of extracts of Marglobe and Bonnie Best Plants. Untreated Marglobe juice inhibited the growth of the fungus in pure culture. The inhibitory agent in the juice was destroyed by autoclaving or ultrafiltration. The fungus grew well on untreated Bonnie Best juice. These more or less preliminary experiments serve to indicate that the immunity of Marglobe to wilt disease is due, in part at least, to a chemical substance in the juice of the plant which inhibits the growth of the fungus. A new method of inoculating the plants through the stems was perfected during the past year.

This method promises to give a much greater percentage of infection than the old methods.

Chromosome Studies in the Genus Ipomoea and the Genus Gladiolus: In a previous report (June, 1933) the progress on this project was reported by considering the arbitrary phases into which work had been confined. These will be considered again, as follows:

1. Collections: During the past year more species and varieties have been acquired. The interesting feature is that the new additions represent critical species or varieties when considered in relation to those which are of commercial importance. We probably have the largest growing collections of either in this country, not considering those dealers who have enormous numbers of commercial varieties. This phase may be summarized as follows:

	1932	1933	1934
Ipomoea			
Species and varieties.....	16	57	70
Gladiolus			
Species and varieties.....	6	58	82

We have included species and varieties together because in some cases we are not sure of the proper designation.

2. Nomenclature: The location of an excellent monograph on each genus cleared up many of the questionable types and this is practically true of the genus *Ipomoea*, where everything that has that type of flower and climbs has at one time or another been included in the genus. Examination of the specimens in the National Herbarium has not helped materially since both collections have never been worked over to any extent.

3. Chromosome Studies: *Ipomoea.* We expect to publish a paper on this phase of the work soon. An examination of nearly forty species and several commercial varieties reveals the chromosome number to be thirty. Even those types which approximate the sweet potato (*I. batatas*, whose chromosome number is 78, plus or minus) in growth and root development fall in the thirty category. This situation is not parallel to any reported in the literature on hand at present. We feel this is the point to stress in publication. We have recently secured flower material from Porto Rico, through the courtesy of Dr. B. F. Lutman of the Vermont Agricultural Experiment Station, and we hope to check the high number of the sweet potato in its haploid phase. We have had some success with flower material of the other species and varieties but this is still very disturbing. Six different methods have been used without any consistent results. This growing season gives us another chance.

Gladiolus. The successful germination of a number of cormels has allowed us to make determinations of the chromosome numbers in the root tips. Apparently there are four distinct categories: (1) the majority of the wild species from South Africa (chromosome number, 30- 2^n) ; (2) the bulk of the commercial varieties, and some species used in improving the latter (chromosome number, 60- 2^n) ; (3) the Asiatic wild species (chromosome number, 80-90- 2^n) ; and (4) a group of recent so-called species hybrids to which varietal names have been attached (chromosome number, 45 or 46- 2^n). With only this information a great deal of speculation is possible, particularly from the commercial standpoint.

Plant Pathology:

Dr. J. W. Heuberger's dissertation on the cytology of some of the sexual phenomena in common brown-rot sclerotinia gives a fine understanding of the fundamental cell activities in producing the various stages of a parasitic fungus and leads to an explanation of the male sex spores in the higher fungi about which little is known. No further research in this project is planned after publishing.

Dr. Florence Simonds showed the minute structures in the production of Septoria leaf spot in tomato gives a clear picture of what goes on in such a fungus attack. The striking behavior of the Septoria germ tube in entering through the epidermal cells, rather than into the stomata from which it seems to be repelled, and then growing between the cells of the leaf, may lead to some method of attacking such parasites not yet seen. With publication of results this project will be completed.

Considerable progress has been made on the new strawberry root disease project in selecting fields for observation and experiment, in collecting samples and isolating organisms from them, and survey of disease areas.

The pea improvement and other resistant crop breeding work by Professor Temple is progressing well.

The potato seed investigations by Dr. Jehle show continued successful results. Potato spraying tests this year were very effective. Dr. Jehle is continuing the tobacco disease control and plant disease survey in cooperation with U. S. D. A.

Carnation disease and apple scab have had less attention this year.

Plant identification and disease diagnosis for many Maryland citizens and for other members of our staff takes much time, but is a valuable service and continually adds to the accumulating knowledge of the plants found in this State.

ENTOMOLOGY

This department has made fine progress on most all of their projects. Much attention has been given to the corn earworm, the oriental fruit moth, the potato tuber moth, the codling moth, and parasites for the control of the Japanese beetle. Detailed reports of the results in some of the projects will be issued soon in bulletins.

This department cooperated with the Federal Bureau of Entomology under Civil Works Administration funds on the control of pest mosquitoes. 2048 men were employed and approximately 175 miles of ditch were constructed in 18 working days.

HOME ECONOMICS

Publications were issued during the year on flour from Maryland wheat for cake and biscuit making, and on home and family adjustments to present day needs. The latter was a mimeographed report. A more complete report will be printed.

During the year a compilation and comparison of the pure food laws relating to dairy and poultry products was made of Maryland and some of the states having similar marketing conditions.

HORTICULTURE

As will be noted in the list of projects which follows, there are a large number in horticulture. The work on these projects has been very active and much additional information has been gotten. The results of a number of the research problems are being compiled for publication. The manuscripts for six bulletins are about completed and will be issued soon. Much work has been done the past year, in cooperation with the U. S. Bureau of Plant Industry, on the removal of spray residues from fruit. This is one of the important problems which has recently become serious because of the low tolerance which has been established.

The University received an allotment of Federal C. W. A. funds for labor and supplies for improvements at the Sunny Side farm. This has proven of great help and enabled much to be done in clearing and draining the land, improving the roads and repairing of the buildings which would not have been possible otherwise.

The floriculture division of this department has begun the development of a small arboretum which is to serve as a source of plant material for research and teaching. This is being developed on the "Truan" area which has recently been acquired by the University.

POULTRY

This department is very much handicapped in expanding their research program because the present plant is to be moved. Plans are being made to provide a new location. Fortunately much data had been accumulated and the time of the members of the department is well employed in compiling and preparing the results for publications.

No projects were completed during the year. Bulletin No. 359, Feed Consumption Studies Based on the Six Maryland Egg Laying Contests, was completed and published during the year. In arranging the data for this publication the ground-work was laid for several additional studies on management problems. It is hoped that there will be sufficient opportunity to complete some of these studies in the near future.

Some additional attention was given to revising and rechecking the manuscript on The Preservation of Poultry Manure.

A preliminary manuscript has been prepared on Breeding for Resistance to Pullorum Disease. The seventh generation of chickens is being raised this year and additional evidence that hereditary factors are involved in a natural control of the disease has been obtained. As mentioned in previous reports, this project should be expanded by facilities for raising a larger number of specimens. If facilities for expansion are not available on our own plant it may be that we can arrange to have some farmer raise a large flock for us.

As in former years a number of miscellaneous experiments have been carried on as opportunity has presented. Feed tests of samples of suspected deleterious feeds have been continued.

We have yet to reproduce the trouble suspected by the home poultry raiser in our check chicks.

TOBACCO

The research on tobacco is conducted in cooperation with the U. S. Department of Agriculture Tobacco Investigation Division. Two bulletins have been issued during the year giving the results of some of these projects.

LIST OF ACTIVE PROJECTS. 1934-35

Agricultural Economics:

- A-15. The Supply and Distribution of Maryland Tobacco.
- A-18. The Organization and Management of Maryland Farms.
- A-18-a. Insurance and Credit Problems of Maryland Farmers.
- A-18-c. Farming on Small Acreages in Maryland.
- A-18-d. The Dairy and Milk Situation in Maryland Compared with Other Markets.
- A-19. The Farm Tax Problem in Maryland.
- A-19-a. Possible Economy and Increased Efficiency in Local County Government Through Redistricting the State.
- A-25. A Study of Roadside (Dairy Products) Markets in Maryland.
- A-26. An Economic Analysis of the Present Status of Marketing Fruits and Vegetables by Motor Truck.

Agricultural Engineering:

- R- 3. Development of a Small Electric Pasteurizer.
- R- 4. Soil Sterilization.
- R- 5. Temperature Control in Electric Heated Hot Beds.
- R- 6. The Use of Electric Heat in Growing Mushrooms.
- R- 7. Electric Fruit and Vegetable Drier.

Agronomy—Crops:

- B-38. Corn.
- B-39. Wheat.
- B-41. Barley.
- B-42. Hay, Forage and Pasture.
- B-43. Annual Legumes.
- B-44. Sugar Corn.
- B-45. Miscellaneous Projects (Crop Rotation).
- B-47. Studies on the Reproductive Capacity of the su (sugar) Factor in Relation to the Su (Starch) Factor in Corn.
- B-48. The Effective Sex-Ratio in Corn and Its Relation to Yield.

Agronomy—Soils:

- O-25. Effect of Organic Matter on the Fertility of Leonardtown Loam.
- O-27. Field Studies of the Fertility Requirements and Management of Important Soil Types.
- O-28. Fertilizer Studies with Early Potatoes and Sweet Potatoes.
- O-31. Soil Fertility Studies in Relation to Tcbacco Brown Root Rot.
- O-32. The Fertilizer Requirements of Sugar Corn for Canning.
- O-33. Efficiency of Soil Fertility Management.
- O-34. Field Study of Fertility Requirements of the Tcbacco Crop on Sassafras Soil at Cheltenham.
- O-35. Fertilizer Placement Tests.
- O-36. Availability of Phosphorus in Maryland Soils.
- O-37. Fixation of Phosphorus in Maryland Soils.
- O-41. Eradication of Crabgrass.
- O-42. Effects of Fertilizer on Fertility and Grass Population of Pastures.

Animal Husbandry:

- C- 6. Study of Quality in Maryland Hams.
- C-13. The Breeding of Flock Ewes Suitable for Early Lamb Production.

Biological Laboratory:

- D-28. A Study of the Methods of Transmission of the Causative Agent of Black-head in Turkeys.
- D-31. Bang's Disease: A Study of the Economics of Clean and Infected Herds.
- D-34. Bang's Disease: To Attempt to Isolate Brucella Abortus from the Urine and Feces of Cattle.
- D-35. Bang's Disease: To Determine the Percentages of Mastitis in Negative, Suspicious and Positive Animals.

Botany:

- F- 1. Botanical Survey of Maryland.
- F- 2. Identification of Plants.
- F- 3. Weed Identification and Eradication.
- F- 4. The Botany of Maryland Trees.
- F- 5. Effects of the Chemical Treatment of Pollen on Inheritance.
- F- 7. Chromosome Studies in the Genus Ipomora and the Genus Gladiolus.

Dairy Husbandry:

- G- 3. Control of Contagious Abortion in the Experiment Station Dairy Herd.
- G-10. A Study in the Production of Naturally and Mechanically Produced Soft Curd Milk.
- G-11. Growth Data on Dairy Animals from Birth to Freshening Age.
- G-13. Factors Affecting the Stability of Whipped Cream.

Entomology:

- H-21. Biology and Control of Some Greenhouse Pests.
- H-22. Repelling Stable Flies.
- H-23. A Study of Laspeyrcsia Molesta Busck in Maryland (Oriental Peach Moth).
- H-24. Winter Protection of Bees.
- H-25. Biology and Control of the Peach Tree Borer.
- H-26. Dusting Peach and Apple Trees for the Control of Insects and Diseases.
- H-27. Insecticide Investigations: Sub-title: The Chemical, Physical and Insecticidal Properties of Pine Tar Creosotes and Some Allied Products, etc.
- H-28. Methods for the Control of the Potato Tuber Moth.
- H-29. Corn Earworm—Life History and Control.
- H-30. Apple Insects—Apple Plant Lice.

Entomology :—(Continued)

- H-34. Study of Insecticidal Properties of Pyrothum and Its Products.
- H-35. Nursery Insects.
- H-36. Insecticide Investigations.
- H-37. A Study of the Pollination of Cantaloupes.

Floriculture:

- I-17. A Study of Calyx Splitting in Carnations.
- I-18. Effect of Soil Types on Yields of Greenhouse Crops, Carnations.
- I-19. Breeding and Selection of Snapdragons.
- I-20. Effect of Time of Ripening of Bulb on Forcing Qualities of Gladiolus.
- I-21. Treatment of Greenhouse Soil in Solid Beds.

Home Economics:

- R- 5. Methods of Cooking as a Factor in Palatability of Hams.

Plant Pathology:

- J-44. Annual Plant Disease Survey.
- J-45. Botanical Survey of Maryland.
- J-46. Identification of Plants.
- J-48. Carnation Diseases.
- J-50. Varieties Resistant to Disease.
- J-69. Tobacco Disease.
- J-71. Apple Scab.
- J-72. Potato Seed Control.
- J-78. Strawberry Root Diseases.

Plant Physiology:

- K- 7. Physiological and Biochemical Aspects of Vegetable Storage.
- K-16. Symptoms of Mineral Nutrient Deficiencies in Plants with Special Reference to Tomatoes.
- K-17. A Physiological Study of the Resistance and Susceptibility of Tomato Plants to Fusarium Wilt.
- K-18. A Physico-Chemical Study of the Soluble Polysaccharides in Sweet Corn.
- K-19. A Study of the Relative Importance of External Factors on the Ratio of Bound and Free Water in Plant Tissues.

Plant Propagation:

- E- 1. Plant Propagation with Special Reference to Cuttings.

Pomology:

- L-40. The Breeding of Blight Resistant Pears.
- L-45. Fruit Spur and Biennial Bearing Studies of Apples.
- L-47. The Effect of Varying the Length of Day on Plant Growth and Chemical Composition.
- L-48. The Fertilization of Apple Orchards.
- L-49. The Fertilization of Peach Orchards.
- L-50. Sod Versus Tillage for Apple Orchards.
- L-51. The Propagation of Apple Trees on Their Own Roots.
- L-52. The Fertilization of Strawberries.
- L-53. The Effect of Bud and Spur Defoliation on Fruit Bud Formation.
- L-54. The Influence of Pollination on Fruit Yields.
- L-55. Experiments in Grape Training and Pruning.
- L-57. Peach Pruning Experiments.
- L-58. The Breeding of Early Colored Grapes.
- L-59. Variety Tests of Apples, Peaches, Pears, Plums, and Cherries.
- L-60. Variety Tests of Grapes and Strawberries.
- L-61. Variety Tests of Bush Fruits.
- L-62. Transplanting Studies with Trees.
- L-63. Collection of Phenological Data.
- L-64. Apple Breeding and Testing of New Seedlings.
- L-65. An Economic Study of Peach Cling Varieties for Canning.
- L-66. An Economic Study of Peach Planting Distances.
- L-67. A Study of Factors Influencing the Red Color in Apples.
- L-68. A Study of the Effect of Nitrogen and Other Fertilizers on the Firmness of Flsht, Shipping Quality and Keeping Quality of Various Fruits.
- L-69. Studies of the Effect of Different Nitrogenous Fertilizers on Orchard Fruits.
- L-71. Removal of Spray Residues from Fruits and Vegetables.

Poultry :

- M-28. Egg Laying Competition—(1) Season Distribution of Eggs as Influenced by (a) Rate of Production (b) Feed Rations; (2) Semi-automatic System of Feeding; (3) Studies of Mineral Consumption.
- M-29. Tests of Special Methods for Drying and Pulverizing Poultry Manure as It Comes from the Droppings Boards.
- M-30. A Controlled Test to Determine the Efficiency of Approved Good Management in the Control of Bacillary White Diarrhea.

Ridgely Farm:

- S- 1. Growing Multiplication Plots of Mammoth Red Wheat for Distribution.
- S- 2. The Use of Fertilizers in the Rotation of Corn, Wheat, Hay and Tomatoes.
- S- 3. Tests with Late Potatoes, New Varieties and Seedlings.
- S- 4. Variety and Fertilizers Tests of Strawberries.
- S- 5. Experiments with Sweet Potatoes, Cantaloupes, Multiplication of Types.
- S- 6. Experiments with Garden Peas for Canning.
- S- 7. Tests of Varieties of Tomatoes and Early Plants on Total Yield.
- S- 8. The Effect of Lime With and Without Fertilizers and Manure.
- S- 9. Tests of Different Kinds of Lime on Alfalfa.
- S-10. Variety Tests of Corn, Wheat and Soybeans.
- S-11. Tests of New Selections of Wheat.

Seed Inspection:

- N- 7. Inspection of Seeds Sold Throughout the State Each Year.
- N- 8. Examination of Samples Taken from Seeds Sold Throughout the State Each Year.
- N- 9. Examination of Samples Submitted to the Laboratory Each Year.
- N-10. Identification of Seeds Submitted to the Laboratory from Time to Time.
- N-11. Studies of Observed Variations Among Germination Tests.
- N-12. Studies of Changes in Weight of Various Components of Seed Samples and the Resulting Effects on the Percentage Compositions.
- N-13. Economic Use of Seeds.

Tobacco Investigations:

- P- 1. Tobacco Breeding and Variety Tests.
- P- 2. Crop Rotation Tests with Tobacco.
- P- 3. Effects of Crops on Yields of Succeeding Crops in the Rotation with Special Reference to Tobacco.
- P- 4. Fertilizer Tests and Studies in the Nutrition Requirements of the Tobacco Plant, with Reference to Both Quality and Yield of Leaf Tobacco.
- P- 5. Improved Methods of Handling Seed Beds, Including Steam Sterilization.
- P- 6. Nutritional Deficiency Studies.

Vegetable Gardening:

- Q-58. Peas—Factors Influencing Yield and Quality of Canning Peas.
- Q-59. Rhubarb—Chemical Fertilizers with Special Reference to Sulfate of Ammonia.
- Q-60. Cantaloupes—Breeding and Selection.
- Q-61. Sweet Potatoes—Best Size Roots for Plant Production and the Effect on Yields.
- Q-62. General Fertility Problems: Maintaining the Fertility of Land for Garden Crops.
- Q-63. Testing New Varieties and Strains of Vegetables.
- Q-65. Planting Distances and Different Formulas of Fertilizers for Vegetables.
- Q-66. The Selection of a Strain or Strains of Spinach That Will Meet the Market and Canners' Requirements.
- Q-67. Tomatoes:
 - A. Breeding and Selection of Varieties for Canning.
 - B. The Influence of Green Manures Supplemented by Commercial Fertilizers on Tomatoes.
 - C. Economic Value of Certain Cultural Conditions on the Yield and Quality of Raw and Manufactured Tomato Stock.
 - D. Effect of "Rested" Land Versus Cultivation and Green Crops on Production.
- Q-68. Yielding Capacity and Qualities of Different Varieties of Beans.
- Q-70. An Economic Study of Grade, Maturity, Composition, and Canning Quality of Corn as Influenced by Seasonal and Cultural Conditions.
- Q-71. Potato Breeding and Inheritance.
- Q-72. A Study of the Factors Affecting the Development of Red Color of Canned and Raw Stock Tomatoes and of Market Garden Tomatoes.
- Q-73. An Economic Study of Canning Crops in Rotation with Special Reference to Physiology and Pathology of Canning Peas.

FINANCIAL RESOURCES AND EXPENDITURES

The research work is maintained chiefly by Federal and State appropriations. This is supplemented by farm sales and some small private contributions from time to time for special projects. The Federal acts outline the functions and character of work to be undertaken. The State appropriations are used mostly for general maintenance and executive expenses and to supplement the Federal funds.

The amount appropriated by the State for this fiscal year was 40% less than for the previous biennium. This necessitated some curtailment in force and extent of work. Nevertheless, some additions have been made to the laboratory equipments and the facilities for research have been improved. Most laboratories are now well equipped. There is a fine spirit of service among the Staff and real progress has been made.

The following financial statements give the details as to the appropriations and expenditures:

MARYLAND AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH UNITED STATES APPROPRIATION

Dr.	Hatch Fund	Adams Fund	Purnell Fund
To Appropriations for Fiscal Year, 1933-1934.....	\$15,000.00	\$15,000.00	\$60,000.00
<hr/>			
Cr.			
By Salaries	\$13,582.86	\$12,505.00	\$44,699.76
Labor	769.50	504.00	3,648.47
Stationery and Office Supplies.....			80.39
Scientific Supplies	15.28	262.85	1,676.57
Feeding Stuffs			16.75
Sundry Supplies		54.46	864.03
Fertilizers			644.67
Communication Service	69.10		29.98
Travel			1,410.23
Transportation of Things.....			34.66
Publications	563.26		825.28
Heat, Light, Water and Power.....			20.44
Furniture, Furnishings and Fixtures			488.13
Library			16.00
Scientific Equipment		1,662.59	5,260.72
Tools, Machinery and Appliances.....		11.10	283.92
Totals	\$15,000.00	\$15,000.00	\$60,000.00

**MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH
THE STATE APPROPRIATIONS**

Dr.	General Fund	Ridgely Farm
Balance June 30, 1933.....	\$54,444.85	\$74.09
Receipts for Year 1933-1934.....	\$54,444.85	3,826.44
Totals.....	\$54,444.85	\$3,900.53
<hr/>		
Cr.		
By Salaries	\$19,715.35	\$1,520.00
Labor	11,377.44	1,278.45
Stationery and Office Supplies.....	215.48	.36
Scientific Supplies	635.72	
Feeding Stuffs	6,922.76	21.25
Sundry Supplies	1,716.35	161.86
Fertilizer	1,065.72	113.86
Communication Service	447.38	33.70
Travel Expenses	467.46	91.60
Transportation of Things.....	725.78	12.80
Publications	1,540.34	
Heat, Light, Water and Power.....	2,982.33	
Furniture, Furnishings and Fixtures.....	201	
Library	575.31	
Scientific Equipment	170.13	
Livestock	157.25	
Tools, Machinery and Appliances.....	1,010.90	201.79
Buildings and Land.....	3,020.27	
Contingent	1,696.87	1.50
Total.....	\$54,444.85	\$3,437.17
Credit Balance June 30, 1934.....		463.36
	\$54,444.85	\$3,900.53

MARYLAND AGRICULTURAL EXPERIMENT STATION
 IN ACCOUNT WITH
 THE STATION FARM FUND

Dr.

Balance June 30, 1933.....	\$1,903.58
Receipts 1933-1934	<u>14,927.11</u>

Total	\$16,830.69
-------------	-------------

Cr.

By Salaries	\$327.06
Labor	7,042.55
Stationery and Office Supplies.....	.50
Scientific Supplies	64.84
Feeding Stuffs	210.58
Sundry Supplies	257.60
Fertilizer	
Communication Service	75.10
Travel Expense	800.22
Transportation of Things.....	42.21
Publications	15.50
Heat, Light, Water and Power.....	39.44
Furniture, Furnishings and Fixtures.....	
Library	2.00
Scientific Equipment	300.00
Livestock	24.00
Tools, Machinery and Appliances.....	16.30
Buildings and Land.....	145.76
Contingent	182.83
Total	\$9,546.49
Credit Balance June 30, 1934	<u>7,284.20</u>

\$16,830.69

MARYLAND AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH
REGULATORY AND PUBLIC SERVICE FUNDS

	Dr.	Biological Laboratory	Seed Inspection
Balance June 30, 1933.....		\$947.75	
Receipts for Year 1933-1934.....		11,247.72	\$7,322.25
Total.....		\$12,195.47	\$7,322.25
 Cr.			
By Salaries		\$3,718.68	\$6,250.04
Labor		2,142.94	196.25
Stationery and Office Supplies		114.65	35.71
Scientific Supplies		121.69	110.93
Feeding Stuffs		431.73	
Sundry Supplies		1,358.22	238.66
Communication Service		480.61	177.96
Travel Expense		7.65	157.33
Transportation of Things		200.03	
Heat, Light, Water and Power		1,089.35	
Furniture, Furnishings and Fixtures		30.00	37.84
Library			19.88
Scientific Equipment		510.00	
Livestock		2.10	
Tools, Machinery and Appliances		20.75	21.79
Buildings and Land		30.00	
Contingent		130.78	50.38
Total.....		\$10,389.18	\$7,322.25
Credit Balance June 30, 1934.....		1,806.29	
		<hr/>	<hr/>
		\$12,195.47	\$7,322.25

